Fairfax County
Stream Protection Strategy
Baseline Study

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Prepared By:

Stormwater Management Branch
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Department of Public Works and Environmental Services

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John Galli	*Washington Metropolitan Council of Governments*
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ABOUT THIS DOCUMENT

The purpose of this report is to provide a baseline summary of general stream conditions across Fairfax County. This document does NOT contain any additions or amendments to County policy. Rather, it is intended for use as a planning tool by County policy makers and to serve as a reference point for future study. This report highlights the need for further investigation in many areas throughout the County.

If you encounter a problem pertaining to a County stream, please refer to the County's Environmental Services Directory at the following web address:

http://www.co.fairfax.va.us/gov/dpwes/environmental/environmental_concerns.htm

Alternatively, you can call the County Environmental Hotline at (703) 324-1937.

EXECUTIVE SUMMARY

Introduction

Prior to the 1940's, Fairfax County was largely rural and agricultural. Since that time, the landscape has been transformed into one dominated by suburban communities interspersed with highly developed urban centers. This shift from natural, vegetative ground cover to areas of impervious surface dramatically increases rainfall runoff and stream flow volumes during storm events. Rather than infiltrating the soil as it would under natural conditions, rainwater instead flows rapidly from rooftops, parking lots, and roadways, and is quickly directed toward streams via a conveyance system of roadside gutters, ditches, and storm sewer drains. The resulting high flows rapidly erode the channel of the receiving stream, leading to degradation of the entire downstream environment.

The need to protect the living environment while planning for orderly development and redevelopment of the County has long been recognized. There is a direct link between the vitality of ecological resources and the quality of life for citizens. Streams beginning in Fairfax County eventually flow into the Potomac River and then enter the Chesapeake Bay, and the measures taken by the County to improve stream quality within its boundaries have also been aimed at protecting the downstream environment.

However, despite the efforts taken over the years to mitigate the effects of increasing urbanization, stream degradation continues within the ecosystem. This degradation is evident through increasing stream channel erosion, loss of riparian buffers, decreased aquatic life and poor water quality in general within the County's streams. The purpose of the Stream Protection Strategy (SPS) program is to:

- understand the degree of stream degradation.
- formulate measures to effectively reverse the negative trends.
- identify and prioritize areas with the greatest needs.
- recommend streams for preservation and restoration efforts where appropriate.
- support detailed comprehensive watershed planning or stormwater master plans from which specific capital improvements may evolve.
- integrate applicable environmental policies, initiatives and regulatory requirements.
- provide an additional information base to aid future planning efforts.
- encourage environmental stewardship by supporting established and new citizen stream monitoring programs and public education.

In general, objectives of the program focused on recommendations for protection and restoration activities on a subwatershed basis, prioritization of areas for allocation of limited resources, establishment of a framework for long-term stream quality monitoring, and support for overall watershed management. Although high counts of fecal coliform bacteria are recognized as a serious health risk in some County streams, the focus of this baseline study was on biological indicators of stream water quality. Fecal coliform bacteria counts are subject of continual monitoring by the Fairfax County Health

Department, results of which are published in a separate annual report (refer to the **1999 Stream Water Quality Report**) sections of which are described in Chapter 3, under Other Monitoring.

Fairfax County's SPS program currently supports several ongoing environmental initiatives at the County, State and Federal levels, all of which assist in achieving the goal of preservation and restoration of stream quality. Over time, SPS will become even more integrated with the following programs:

- Watershed management/master plans
- Chesapeake 2000 Agreement implementation
- National Pollutant Discharge Elimination Systems (NPDES)
- Total Maximum Daily Loads (TMDLs)
- Fairfax County's Policy Plan (Environmental Section)
- Citizens Volunteer Stream Monitoring
- Amendments to Public Facilities Manual (PFM), including the Infill and Residential Development Study recommendations
- Stormwater Environmental Utility implementation
- Virginia Riparian Buffer Initiative – Chesapeake Bay Program

A detailed description of the above programs/initiatives and their linkage to SPS is outlined in Chapter 4 of this report.

The results of this SPS Baseline Study are not intended to restrict new development but to provide the basis for more ecologically sensitive and sustainable new development and redevelopment countywide. Detailed goals and objectives are stated in Chapter 1 of this report.

Methods

The field component of this assessment involved the collection of detailed biological and habitat data from 138 stream sites/reaches, 13 of which were established as Quality Assurance/Quality Control (QA/QC) Sites. Of the 125 principal monitoring sites, 114 were reflective of conditions within Fairfax County and 11 were sampling locations in nearby Prince William Forest Park and used to aid in the development of "reference" conditions to which all sites were compared. This report presents the results of a comprehensive baseline study of conditions as they existed in 1999. These results can be utilized to formulate recommendations for strategies to consider in overall management of watersheds to preserve or restore stream quality to levels consistent with County environmental goals and applicable state and federal mandates.

With its emphasis on biological monitoring, the SPS program is an important first step toward improving environmental quality by viewing streams as more than mere conduits of stormwater flow. By tying together information on stream morphology, habitat condition, water chemistry, and current and projected land use patterns, it will provide

an important base for the planning and decision-making framework that will be needed to protect and restore stream ecosystems within Fairfax County.

Research shows that at levels of 10-20% impervious surface cover, habitat quality and biological integrity in stream systems is significantly diminished (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999). Using modified versions of the U. S. Environmental Protection Agency's (U.S.EPA's) Rapid Bioassessment Protocols, the baseline study focused on assessments of channel morphology and the responses of living communities (aquatic insects and fish) to aspects of land use. Spatial analyses of development patterns and watershed imperviousness were conducted within a Geographic Information System (GIS) environment. Details of the methodology and protocols used for the study are outlined in Chapter 2 and Appendix A-H of this report.

A numeric ranking of overall quality was generated for each of the SPS monitoring sites within the County. Each of these ratings were based upon the numeric scores of the following four components of stream/watershed condition:

1) an Index of Biotic Integrity (IBI) incorporating 10 separate measures (each score on a 0 to 10 scale) of benthic macroinvertebrate (insect) community integrity (Figure I),

2) a general evaluation of the watershed features (including vegetation and instream features) as well as a more specific evaluation of 10 parameters, each scored on a scale of 0 (Worst Condition) to 20 (Optimal Condition) condition of in-stream and riparian zone habitat (Figure II),

3) fish taxa richness (number of distinct species present) (Figure III), and

4) calculations of overall percent impervious cover within the contributing drainage area of each site based upon available Fairfax County GIS data layers (roads, parking lots, buildings, sidewalks) (Figure IV).

The ultimate numeric score for each sampling location reflects the site's degree of departure from reference or "highest-quality" conditions. These composite values were then assigned to one of the following qualitative categories: **Excellent, Good, Fair, Poor and Very Poor**.

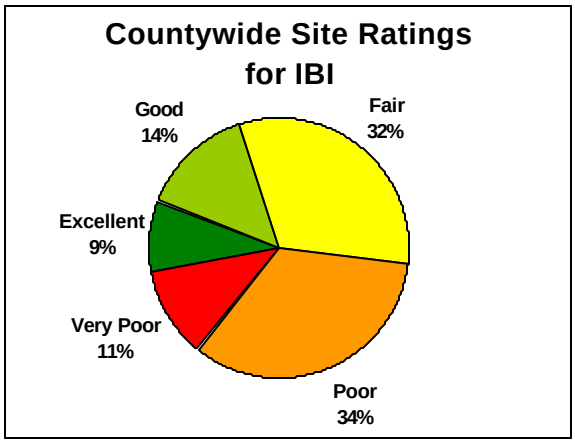

Figure I. Percentage of SPS monitoring sites scoring in each of the five IBI quality categories.

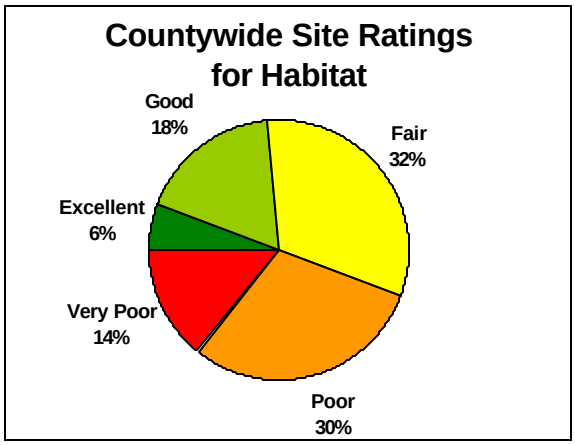

Figure II. Percentage of SPS monitoring sites scoring in each of the five Habitat quality categories.

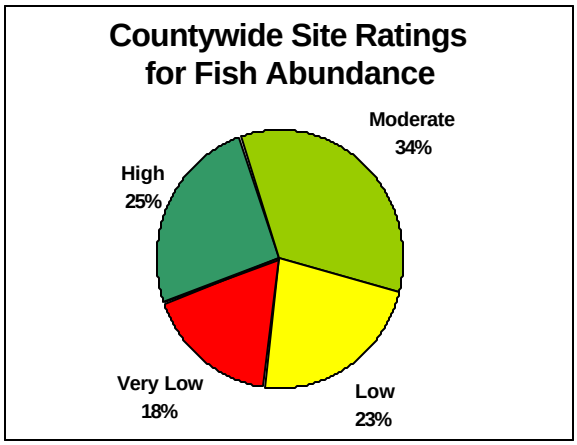

Figure III. Percentage of SPS monitoring sites scoring in each of the four Fish abundance categories.

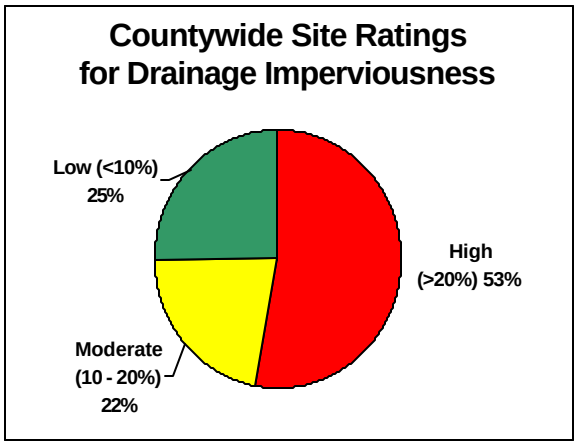

Figure IV. Distribution of Imperviousness at SPS monitoring sites.

RESULTS

Management category recommendations were made based upon both this overall ranking as well as *potential* levels of future development (based on current zoning information) within each respective subwatershed (Figure V). These categories are as follows (value in parenthesis is the percentage of the County falling within each grouping):

Watershed Protection (31.5% of County)

Primary goal: Preserve biological integrity by taking measures to identify and protect, to the extent possible, the conditions responsible for current high quality rating of these streams.

Example Key Management Strategies:

- Consider establishing a zoning overlay to clearly identify these areas as watershed protection areas.
- Evaluate and refine, as needed, existing County regulations and policies to assure continued protection of these watersheds.
- Assess current watershed conditions to identify characteristics and management practices that contribute to the high water quality rating.
- Expand stream valley park acquisition or dedication.
- Conduct public education programs on stream stewardship.

Watershed Restoration Level I (7.2% of County)

Primary Goal: Re-establish healthy biological communities, where feasible, by taking measures to identify and remedy the cause(s) of stream degradation both broad scale and site specific.

Example Key Management Strategies:

- Evaluate, prioritize and construct planned Capital Improvement Projects (CIP) for these watersheds including planned regional ponds and water quality BMP retrofits.
- Evaluate, prioritize and construct stream corridor restoration projects for these watersheds.
- Promote use of innovative BMPs and Low Impact Development Design (LID) techniques.
- Conduct public education programs on stream stewardship.

Watershed Restoration Level II (61.3% of County)

Primary Goal: Maintain areas to prevent further degradation and implement measures to improve water quality to comply with Chesapeake Bay Initiatives, Total Maximum Daily Load (TMDL) regulations and other water quality initiatives and standards.

Example Key Management Strategies:

- Implement a watershed approach to evaluate and prioritize restoration in these subwatersheds. Focus on restoring tributaries and headwaters prior to active restoration in mainstem segments.
- Select sites and implement monitoring of tributaries identified as “Assessment Priority Areas”.
- Identify, prioritize and implement projects to help stabilize critical areas with severe stream bank erosion.
- Identify and prioritize potential stormwater management retrofit opportunities.

- Promote use of innovative BMPs and reduction of imperviousness for infill and redevelopment.
- Conduct public education in stream stewardship.
- Promote programs like Adopt-A-Stream to increase public involvement.

Many of the key management strategies such as public outreach and promotion of low-impact development techniques have applications in all three watershed management categories. These management strategies will need to be integrated into a comprehensive watershed management approach on a countywide and subwatershed level. Countywide management strategies include prioritizing the 14 watershed groups, implementing watershed master planning, improving stream protection policies and promoting citizen involvement. Individual watershed management strategies include setting priorities for subwatersheds within a given watershed, defining additional stream monitoring needs and eventually implementing selected stream restoration projects. These strategies will need to be further developed into a comprehensive plan for stream protection and restoration.

These categories are intended for use only as planning level tools. Each category is characterized by a set of goals and strategy recommendations that best suit the respective stream environments given current subwatershed development patterns, likely future imperviousness and the assessments of biological condition detailed in this report. In addition, management categories are not intended to be a means of controlling development or to be confused with adopted land use categories contained within the County's Comprehensive Land Use Plan, or other land use documents currently guided by the County Ordinance. Rather, management categories propose a new technique to group targeted areas that might be recommended for similar treatment for more effective future watershed protection, preservation and restoration efforts. Actual implementation of the recommended treatment might entail more detailed study through watershed master plans and/or necessitate a re-examination of some existing policies and plans through a different process.

Chapter 3 contains detailed watershed by watershed descriptions, summary of conditions by both County staff's and volunteer groups monitor data and designated management category recommendations with watershed strategies. Some of these strategies, by themselves, represent established steps and initiatives currently being implemented in the County and neighboring jurisdictions. However, SPS attempts to organize these strategies in a more logical manner to foster a more effective watershed planning and management approach. The strategies outlined in this report by no means represent an all inclusive list, rather they will serve as the foundation of a process to identify potential strategies that may require further evaluation for applicability on a subwatershed scale.

Countywide Management

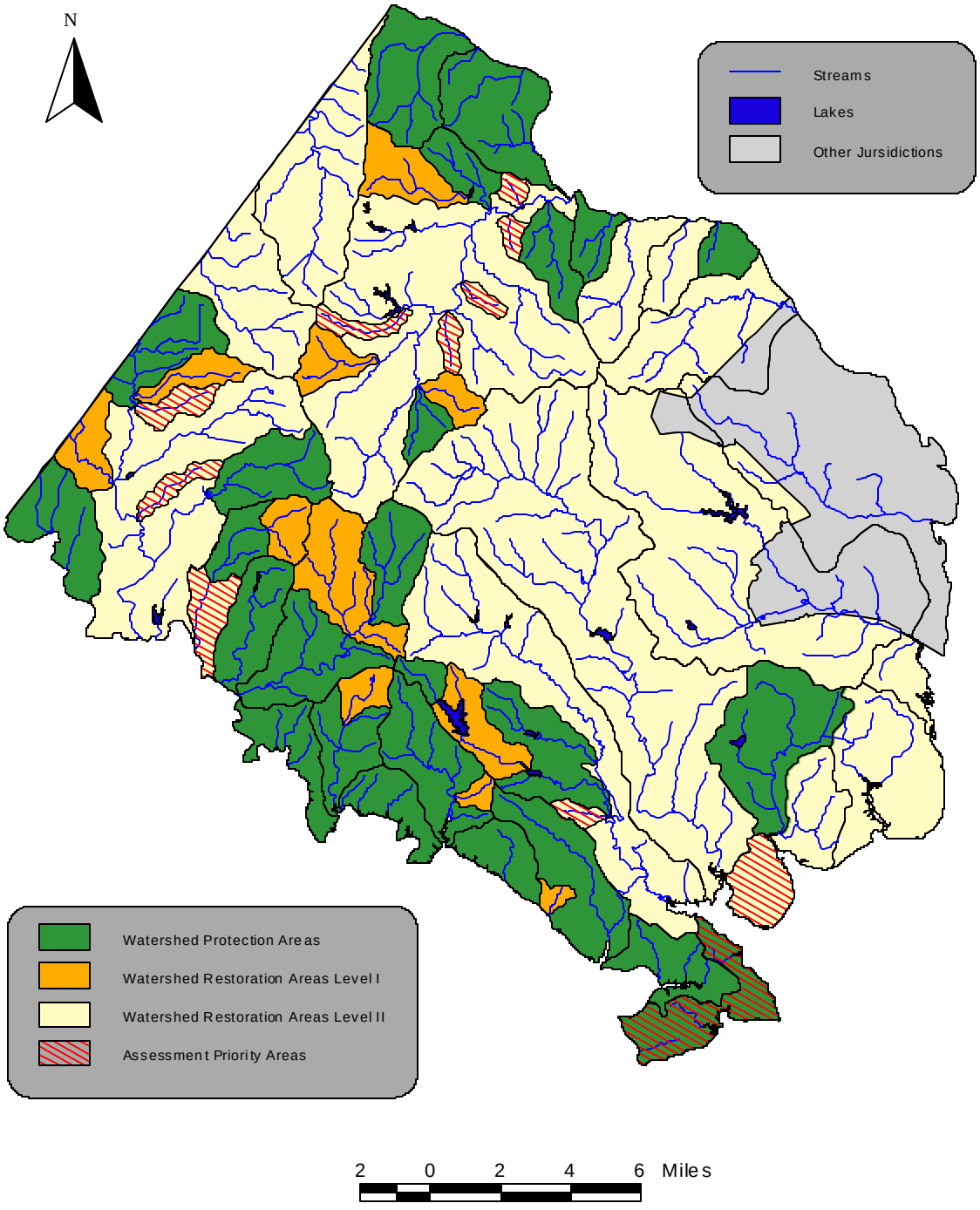

Figure V. Management recommendations for Fairfax County watersheds.

CONCLUSIONS AND RECOMMENDATIONS

Consistent with what has been reported in the literature (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999) this study showed a statistically significant relationship between drainage area, imperviousness and biological quality at a site (see Appendix B for details on the statistical analyses). Figure VI shows the relationship between biological integrity and drainage area imperviousness. The trend line shown in the figure is presented to highlight the fact that impervious area generated during development is correlated with declining stream quality as measured by macroinvertebrate community health. However, the relationship in its current form (linear) should not be used for predictive purposes since that would require a more detailed statistical analysis.

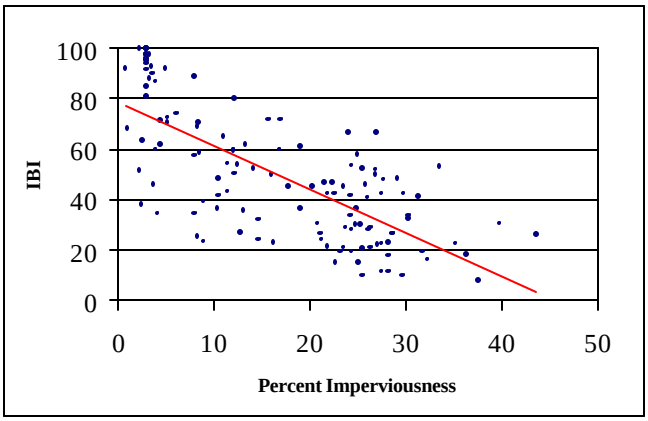

Figure VI. Trend line indicating that Biological integrity, as measured by an Index of Biotic Intetrity (IBI) for benthic macroinvertebrates, generally decreases with increasing percent imperviousness. Appendix B includes information on the statistical significance of the data presented.

The systems of high biological and habitat integrity that still exist within the County's boundaries are typically found only in largely undeveloped watersheds. Conversely, the most degraded streams are those that flow through areas of the most intense development (Figure VII). This pattern is even more pronounced in drainages containing older developments that often lack the more recently developed and sometimes more efficient stormwater controls.

Protecting and restoring stream quality within Fairfax will require a diverse management approach that includes an active and ongoing stream monitoring effort, targeted restoration activities, public education, enhanced stormwater controls, and enhancing channels of communication with the development community. Some of these steps have already commenced or subject of recommendations in the most recent draft of the Infill & Residential Development Study. This baseline study should be seen as only the beginning phase of a permanent monitoring effort that will be needed for effective management of aquatic resources within the County. If appropriate decisions are to be made, trends in stream conditions will need to be identified and assessed over the long term. This is absolutely essential in meeting the requirements and challenges of the new Chesapeake Bay 2000 Agreement and a potential bay-wide TMDL after 2010 (see Chapter 4 for details). This will require expanding our base of understanding of streams. Components of any future SPS program should involve:

- Continued monitoring of existing SPS sites on a rotating basis involving 20-25% of the County annually.
- Establishing a detailed visual assessment program at the subwatershed level.
- Assessing variables influencing fish community composition and distribution.

- Promoting the expansion of volunteer monitoring efforts.
- Defining and identifying perennial stream network within the County.
- Assessing relative contribution of various sources of instream sediment.
- Evaluation of alternate site selection design to allow for more rigorous analyses.
- Assisting with assessments of effectiveness of various BMP technologies.
- Periodic reassessment of imperviousness at the watershed and subwatershed levels.
- Improving inter-agency cooperation regarding sediment control implementation and maintenance.
- Public education that fosters community interest in stream quality issues.

More detailed recommendations are discussed in Chapter 5 of this report.

Countywide Conditions

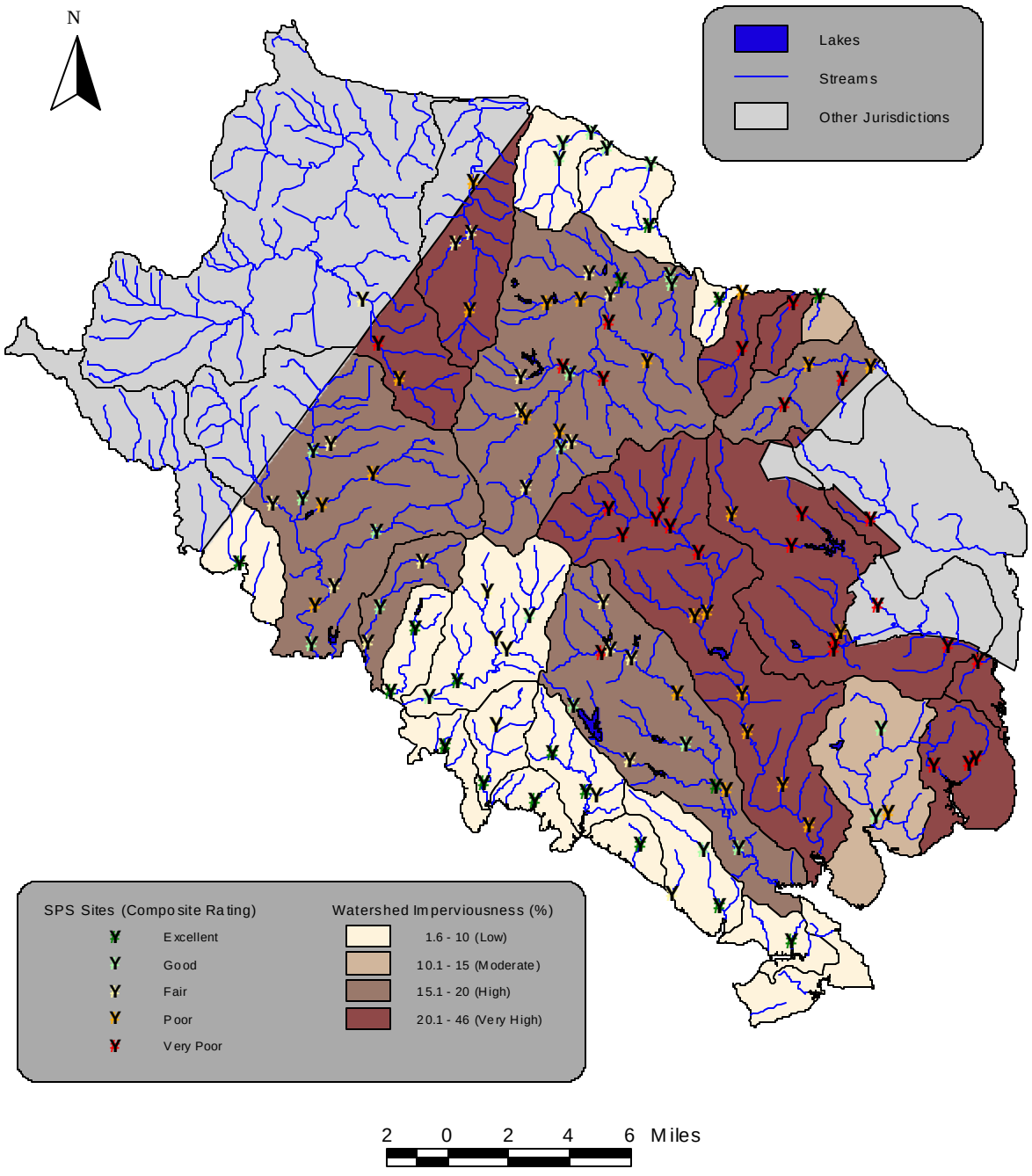

Figure VII. Relationship between imperviousness and overall stream condition